CANDIDATE AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Partula gibba*

COMMON NAME: Humped tree snail; akaleha

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: February 2002

STATUS/ACTION (Check all that apply):
___ New candidate
_X_ Continuing candidate
    _X_ Non-petitioned
    ___ Petitioned - Date petition received: ___
        ___ 90-day positive - FR date: ___
        ___ 12-month warranted but precluded - FR date: ___
_____ Is the petition requesting a reclassification of a listed species?
    ___ Listing priority change
        Former LP: ___
        New LP: ___
___ Candidate removal: Former LP: ___ (Check only one reason)
    ___ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
    ___ F - Range is no longer a U.S. territory.
    ___ M - Taxon mistakenly included in past notice of review.
    ___ N - Taxon may not meet the Act's definition of "species."
    ___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Partulidae (snail)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Guam; Commonwealth of the Northern Mariana Islands (Islands of Rota, Agujuan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan).

CURRENT STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Guam; Commonwealth of the Northern Mariana Islands (Islands of Rota, Agujuan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan).

LEAD REGION CONTACT (Name, phone number): Wendi Weber (503/231-6131)

LEAD FIELD OFFICE CONTACT (Office, name, phone number): Pacific Islands Office, Mike Richardson (808/541-3441)

BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

The three genera and 123 tree snail species of the family Partulidae are restricted to the high-elevation Pacific islands of Polynesia (excluding Hawaii), Melanesia, and Micronesia (Cowie 1992 and Paulay 1994). These snails have received increased attention in recent years due to declining numbers throughout their range and due to extinction (Clarke et al. 1984; Murray et al. 1988; Hopper and Smith 1992; Miller 1993). The high islands of the Mariana archipelago historically supported five species of partulid tree snails, and represents the northwestern limit of the geographical range of the Partulidae.

The genus *Partula* has four species found only in the Mariana Islands, and 94 additional species recorded from other Pacific islands. Thirty-seven of these 98 species are extinct in the wild including the Guam endemic *Partula salifana*, which has not been seen since 1946 (Pearce-Kelly *et al*. 1994). An additional 37 species are declining in numbers, and 24 species are of indeterminate status due to insufficient information. The genus *Samoana* is represented in the Mariana Islands by a single species, *Samoana fragilis*. Twenty additional species are recorded from other islands in the Pacific basin. Ten of these 21 species are declining in numbers, including the Mariana Islands endemic species. The status of 11 other species are unknown (Pearce-Kelly *et al*. 1994). Four partulid species are in the genus *Eua*, which are confined to the Polynesian islands of Tonga and Samoa in the south Pacific. One of these is known to be declining in numbers, while the status of each of the remaining three species are unknown (Pearce-Kelly *et al*. 1994).

Overall, 30 percent of the 123 partulid species are extinct, and 39 percent are declining in numbers. The current status of 31 percent of the tree snail species cannot be characterized due to insufficient information. In no case has a partulid tree snail species been shown to have stable or increasing numbers of individuals or populations.

The biology of several of the partulid tree snails of the Mariana Islands is currently being studied by B.D. Smith at the University of Guam (B. Smith, pers. comm. 1996). While detailed information from these studies is not currently available, general information on the biology of closely related partulid tree snails have been published and reviewed by Cowie (1992). As with all terrestrial pulmonate snails, the Mariana Islands tree snails are hermaphroditic. In general, partulid snails begin reproducing in less that 12 months and may live up to 5 years. Up to 18 young are produced each year and some species, such as the humped tree snail (*Partula gibba)* of the Mariana Islands, may be self-fertile. While most terrestrial snails lay eggs, the partulid tree snails give birth to fully developed young. The snails are generally nocturnal, living on bushes or trees and feeding on decaying plant material. There are no known natural predators of these snails, although many of these species are currently threatened by alien snail predators. The Partulidae, including those of the Mariana Islands, prefer cool, shaded forest habitats (Crampton 1925; Cowie 1992; Smith 1995) with high humidity and reduced air movement that might otherwise lead to excessive water loss.

Partula gibba was first collected on Guam in 1819 by Quoy and Gaimard during the

Freycinet Uranie expedition of 1817-1819 (Crampton 1925). *Partula gibba* is the most widely distributed tree snail in the Mariana Islands and is known from Guam, Rota, Aguijan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan. Upon its discovery, this snail was considered to be the most common tree snail on Guam, occupying the branches of trees in cool and shaded habitats (Crampton 1925). Sixty-nine years later, this species is considered to be rare throughout its range (Hopper and Smith 1992).

Since the work of Crampton (1925), no significant evaluation of *Partula gibba* occurred until the 1980s and 1990s. In 1989, Hopper and Smith (1992) resurveyed 34 of Crampton's 39 sites on Guam plus 13 new sites. Crampton (1925) found *Partula gibba* at 33 of the 39 sites and collected between 2 and 412 snails at each site; a total of 3,204 individuals were collected. The actual population sizes were probably considerably larger since the purpose of Crampton's collections were to evaluate geographc differences in shell patterns and not to assess population size. None of the 34 sites resurveyed by Hopper and Smith (1992) still supported these snails in 1989.

Of the 13 new sites surveyed by Hopper and Smith (1992), only one supported a small population of *Partula gibba.* Additional surveys by Smith (1995) found two additional populations of *Partula gibba.* Service surveys of 15 sites on the Guam Naval Magazine found no additional populations, while ground shells of tree snails were found in abundance at all locations (Miller and Asquith, Service, Pacific Islands Office, pers. comm. 1996). All three of the Guam populations of *Partula gibba* are in the same coastal area. One has declined from approximately 100 snails in 1991 to 20 snails in 1995; this area has recently had a new road cut into it, and the decline in this population of snails may be due to the indirect effects of this road. The other two populations are described as being substantial, probably totaling 500 to 1,000 individuals.

Partula gibba has also been recorded from eight of the islands of the Commonwealth of the Northern Mariana Islands: Rota, Agujuan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan. Crampton (1925) surveyed eight sites on the island of Saipan, collecting 6,698 *Partula gibba*. Surveys in 1991 by Smith and Hopper (1994) could not find any snails at 12 sites visited on the island. Only two of Crampton's original eight sites still had the native vegetation needed to support the tree snails. The shells of dead *Partula* tree snails were found at all the survey sites.

The island of Tinian has not been surveyed in recent years. However, the presence and abundance of a predatory flatworm coupled with severe loss of habitat prior to, during, and since World War II, make the continued existence of *Partula gibba* on Tinian unlikely (Smith 1995).

The Island of Rota was recently surveyed for *Partula* tree snails (Smith 1995, and Miller and Asquith, personal communication 1996). Of 25 surveyed sites, only five supported populations of *Partula gibba*. The largest of these may have up to 1,000 snails. However, this population is located along the main road of Rota in an area that is actively undergoing development. The four other populations are small and total less that 600 snails (Smith 1995). The shells of dead *Partula gibba* were found usually in great abundance at all of the locations surveyed . These observations indicate that this island once supported many large populations of

tree snails and that these snails could be found at almost any location.

The island of Aguijan is also a historic site for *Partula gibba*. In 1985, seven adult snails were collected from the west end of the island (Smith 1995). In 1992, snails were observed at three locations on the island (Craig and Chandran 1992). A second survey in 1992 reported two *Partula gibba* on the northwest terrace of the island (Smith 1995).

Partula gibba has also been reported from the remote northern islands in surveys done in 1949 and in 1994. These small volcanic islands are difficult to access and are currently uninhabited, although some are used for agricultural or military activity. The species was first reported in 1949 from six locations (28 adult snails plus numerous juveniles, with 17 adults from one location) on the island of Pagan in a thin breadfruit agroforest and from five locations (339 adult snails plus numerous juveniles, with 49 adults at a typical site) on Alamagan in wet forest (Kondo 1970). These observations probably represent a single fragmented population on each of these small islands.

In 1994, Kurozumi reported snails from Anatahan (19 snails from 3 locations, with 14 snails from a single site) and Sarigan (102 snails from seven locations, with 53 snails from a single site), which are between the more northern Alamagan and the more souther Saipan. Kurozumi (1994) also reported the continued existence of *Partula gibba* on Alamagan (123 snails from 7 sites, with 58 from a single site) and Pagan (22 snails from a single site). As with the Pagan and Alamagan populations, the snails on Anatahan and Sarigan are probably part of two fragmented populations, one on each island.

Partula gibba continues to survive on these northern islands, although since 1949 the species seems to have declined on Pagan and Alamagan Islands by over 70 percent for individuals, and by approximately 27 percent for populations. A similar decline may have occurred on Anatahan and Sarigan Islands as well.

To date, there are 13 known populations on seven islands that still support populations of *Partula gibba*. The best estimate for the total number of remaining snails is under 2,600. The snail is extinct on Saipan. On Guam and Rota, it has gone from being widely distributed and super abundant to being highly localized and rare. In the northern Mariana Islands, its numbers are in decline.

THREATS (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information. **If this is a removal of a species from candidate status or a change in listing priority, explain reasons for change)**:

A. <u>The present or threatened destruction, modification, or curtailment of its habitat or range</u>.

Crampton (1925) described the habitat requirements of the partulid trees snails of the Mariana Islands as follows: "...the indispensable requisites are that there shall be a sufficiently high and dense growth to provide shade, to conserve moisture, and to effect the production of a rich humus. Hence the limits to the areas occupied by Partulae are set by the more ultimate

ecological conditions which determine the distribution of suitable vegetation." In fact, the ecological settings that meet the basic requirements for partulid snail were numerous in the Mariana Islands prior to World War II. They include coastal strand vegetation, forested river borders, and lowland and highland forests (Crampton 1925). Crampton (1925) further describes the intact structure of native Mariana forests as having four general levels: the high trees; the shrubs and *Panadanus*; the cycads and taller ferns; and the succulent herbs. He notes that the Mariana Islands partulid tree snails preferentially live on subcanopy vegetation and do not use the high canopy trees.

Prior to the arrival of humans, the Mariana Islands were believed to be mostly forested (Fosberg 1960, 1971). With the arrival and population growth of the aboriginal Chamorro people 4,000 years ago (Carano and Sanchez 1964), native forests began to be cleared and savanna grasslands began to develop (Mueller-Dumbois 1981). During the Spanish occupation of the Mariana Islands (1521-1899), alien goats, pigs, cattle, and deer were introduced. Extensive herds of cattle were noted on the main islands, with some herds numbering in excess of 10,000 head. Large numbers of pigs, goats, and deer were also present (Engbring *et al*. 1986; Carano and Sanchez 1964). In 1742, the forested areas on the island of Tinian were described as park-like and open (Engbring *et al*. 1986 citing Anson's journal as cited by Walter 1928). These animals, along with extensive logging, further contributed to the expansion of savanna grasslands and directly altered the understory plant community and overall forest microclimate. All of these changes resulted in a continuing decline in area and quality of tree snail habitat.

The German occupation of the Mariana Islands, from 1899-1914, resulted in few ecological changes to the islands, although there was a recorded increase in the populations of Chamorros and Carolinians that settled on Saipan and actively developed coconut orchards (Engbring *et al*. 1986).

Sweeping ecological changes took place during the Japanese occupation from 1914-1944 (Kanehira 1936; Fosberg 1960, 1971; Engbring *et al*. 1986). Extensive removal of native forests for the development of sugar cane was pursued on all of the main islands. These fields covered almost all of Tinian and much of Guam, Saipan, Rota, and Aguijan. In 1920, Crampton (1925) commented on the loss of partulid tree snail habitat. He stated that much deforestation had occurred in the southern half of Guam and that the savanna grassland habitat, which is unsuitable for tree snails, had greatly expanded during "recent centuries". He also notes that extensive wood cutting has reduced the forest canopy.

During and after World War II, dramatic reductions in partulid tree snail habitats (forest, riparian, and coastal strand) occurred on the islands of Guam, Tinian, and Saipan, where major military operations and landings were conducted. Following the war, open agricultural fields and other areas prone to erosion were seeded with tangantangan (*Leucaena leucocephala*) by the U.S. Military (Fosberg 1960). Tangantangan grows as a single species stand with no substantial understory. The micro-climatic conditions are dry, with little accumulation of leaf litter humus, and is particularly unsuitable as partulid tree snail habitat (Hopper and Smith 1992). In addition, native forest cannot reinvade and grow where this alien weed has become established (Hopper and Smith 1992). The post-war establishment and operation of large military bases has also

prevented the return of native forest that could support partulid tree snails. Today on the island of Guam, the U.S. military occupies approximately 17,500 hectares (43,243 acres) or 30 percent of the island, most (90+ percent) of which once was forested habitat that supported the endemic tree snails.

The native tree snail habitat on the main islands of the Commonwealth of the Northern Mariana Islands have been greatly reduced by development and agricultural activities (Engbring *et al*. 1986). For instance, most of the island of Rota was forested in 1932, but by 1935 almost all level areas have been cleared of forest to support sugar cane production and phosphate mining (Kanehira 1936). The only areas left undisturbed are too steep for agriculture, generally along the base of cliffs, which are an extensive geological feature of the island. These areas still support native limestone forests (Fosberg 1960). Aerial photos from the World War II era show parts of Rota riddled with bomb craters and other areas denuded of vegetation primarily from agricultural activity. Following the war, much of this area was given over to cattle grazing, urban growth, and airport development. In some areas, native forest has reestablished (Engbring *et al*. 1986; Falanruw 1989a). In 1988, supertyphoon Roy hit Rota with winds in excess of 240 kilomters/hour (150 miles/hour, defoliating almost all of the forested areas and downing trees, especially along the southeast and northern cliff slopes of the central Sabana (Fancy and Snetsinger 1996). Vegetation changes associated with this storm have opened up forested areas that were excellent habitat for partulid tree snails. These open forests suffer from changes in microhabitat, such as dessication, that make the continued survival of snails unlikely.

Events and changes similar to those described for Rota also apply to the other main islands of the Commonwealth of the Northern Mariana Islands. In the 1930s, the island of Aguijan was mostly cleared of native forest to support sugar cane and pineapple production. The abandoned fields and an abandoned airstrip are now over grown with alien weeds. The remaining native forest understory has greatly suffered from foraging by alien goats and the invasion of weeds. The island of Tinan has seven World War II air fields that are now abandoned, and the northern two-thirds of the islands have periodically been leased by the U.S. Navy as a training site. Approximately half of the island has been given over to cattle grazing. These human activities have almost entirely altered the island's vegetation, which now includes large stands of tangantangan that were aerially seeded by the U.S. Military. *Partula gibba* is probably extinct on Tinian. On the island of Saipan, most of the native forest is gone, having been replaced by mixed second growth forests, savanna grasslands, and dense thickets of tangantangan (due to military aerial seeding). None of these vegetation types provide suitable habitat for *Partula gibba*, which is now extinct on Saipan.

Of the 10 smaller northern islands, only Guguan, Asuncion, Maug, and Farallon de Pajaros (Uracas) are uninhabited and free of goats, pigs, and cattle (Falanruw 1989b). None of these islands are known to suppport populations of partulid tree snails.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Overutilization is not known to be a factor currently affecting any of the partulid tree snails from the Mariana Islands. Future overutilization of this species is not anticipated.

However, necklaces or leis made from partulid snails' shells are occasionally found for sale. Any collection of *Partula gibba* could significantly contribute to the continued decline of the species and the local extinction of specific populations.

C. Disease or predation.

Crampton (1925) states that "There are no other animals in the Mariana Islands whose presence or activities influence the lives or numbers of Partulae, so far as observation goes." Since World War II, several introductions of alien predators have completely changed this historic condition. Predation by the alien rosy glandina snail (*Euglandina rosea*) and the alien Manokwar flatworm (*Platydemis manokwari*) is a serious threat to the survival of all four species of partulid tree snails from the Mariana Islands. The predatory rosy glandina snail is native to the southeastern United States, and was introduced into the Mariana Islands in 1957 by the governments of Guam and the Commonwealth of the Northern Mariana Islands, following the recommendations of the State of Hawaii Department of Agriculture (Eldredge 1988). Since being introduced, this voracious predator of snails has been dispersed by humans throughout the main islands. The rosy glandina snail was imported to these and other Pacific islands as a biological control agent for another alien snail, the giant African snail (*Achatina fulica*), which is an agricultural pest. However, while its effectiveness as a biological control agent against the giant African snail is questionable (Christiansen 1984; Tillier and Clarke 1983; Mead 1961), field observations have established that the rosy glandina snail will readily feed on native Pacific island tree snails, including the Partulidae such as those of the Mariana Islands (Murray *et al*. 1988; Tillier and Clarke 1983; Miller 1993) as well as Hawaiian achatinellid tree snails (Hadfield *et al*. 1993). A study of the diet of the rosy glandina snail on the island of Mauritius in the Indian Ocean showed that this alien predator preferred native snails over the targeted alien giant African snail (Griffiths *et al*. 1993). On some or all of these tropical islands, the rosy glandina snail has expanded its normal terrestrial feeding behavior to include native snails found in arboreal habitats (Hadfield *et al*. 1993; Miller 1993; Murray *et al*. 1988). The rosy glandina snail has caused the extinction of many populations and species of native snails throughout the Pacific islands (Hadfield *et al*. 1993; Miller 1993; Hopper and Smith 1992; Murray *et al*. 1988; Tillier and Clarke 1983). Where it still resides, the rosy glandina snail represents a significant threat to the survival of native Mariana Islands snails, including the four remaining partulid tree snails: *Partula gibba*, *Partula langfordi*, *Partula radiolata*, and *Samoana fragilis*.

Predation on native partulid tree snails by the terrestrial Manokwar flatworm is also a threat to the long-term survival of these snails. This voracious snail predator was introduced into Guam in 1978 and has been spread by humans throughout the main Mariana Islands (Eldredge 1988). It has proven to be an effective biological control agent for the giant African snail, but has also contributed to the decline of native tree snails, in part due to its ability to ascend into trees and bushes that support native snails. Areas with populations of the flatworm usually lack partulid tree snails or have declining numbers of snails (Hopper and Smith 1992).

The first bio-control efforts directed at the giant African snail were conducted on the small island of Aguijan (also known as Aguijan or Goat Island) in the Mariana Archipelago (see Eldredge 1988 for a reviewed the history of the giant African snail in Micronesia). In May 1950,

approximately 400 Kibwezi gonaxis snails (*Gonaxis kibweziensis*) were released on Aguijan Island. One year later, the number of Kibwezi gonaxis was estimated at 21,750, and the number of giant African snails was 1,122,500. Kondo (1952) concluded that this snail predator had little effect on the giant African snail. Two years later, Peterson (1954) observed Kibwezi gonaxis snails feeding on native snail species and on the giant African snail, and cannibalizing its own young. By mid-1954, the population of Kibwezi gonaxis on Aguijan was estimated to be 80,800, and the giant African snail was estimated at 37,600 individuals (Davis 1954). Davis (1954) concluded that this snail predator was approximately 60 percent effective. Based on these conclusions, Kibwezi gonaxis snails were shipped to Hawaii and other Pacific islands for biological control of the giant African snail (Eldredge 1988).

D. The inadequacy of existing regulatory mechanisms.

Currently, no formal or informal protection is given to *Partula gibba* by Federal agencies or by private individuals or groups. In 1996, the Government of Guam listed this species as endangered on Guam (5 GCA, Section 63205.(c), "The Endangered Species Act of Guam"). A refuge overlay is currently being pursued with Federal military landowners on Guam. If successful, this overlay refuge will include one of the three remaining populations of this species.

E. Other natural or manmade factors affecting its continued existence.

Random environmental events can affect the continued existence of *Partula gibba* due to the small numbers of populations and individuals that remain. Random environmental events such as typhoons and droughts could eliminate one or more of the 13 remaining populations. This is especially true due to several life-history features of this and all other partulid tree snails (Cowie 1992): reproductive rates are low; eggs are not laid as in most terrestrial snails, but the young are born live; dispersal is very limited with most individuals remaining in the tree or bush into which they were born. All of these traits make these snails very sensitive to any random event that could lead to a reduction or loss of reproductive individuals.

BRIEF SUMMARY OF REASONS FOR REMOVAL OR LISTING PRIORITY CHANGE:

FOR RECYCLED PETITIONS:

a. Is listing still warranted? ___
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? ___
c. Is a proposal to list the species as threatened or endangered in preparation? ___
d. If the answer to c. above is no, provide an explanation of why the action is still precluded.

LAND OWNERSHIP (Estimate proportion Federal/state/local government/private, identify non-private owners): All but one of the 13 sites are on lands owned by private land owners. The third site is on lands owned by the U.S. Military. Land ownership issues in Guam and The Commonwealth of the Northern Mariana Islands are highly controversial.

PRELISTING (Describe status of conservation agreements or other conservation activities): On Guam the Service is pursuing the establishment of a 11,396 ha (28,158 ac) refuge overlay on military lands. This would cover 19.6 percent of the total land area of the island of Guam, and would include one of the 13 remaining populations of this species.

REFERENCES (Identify primary sources of information (e.g., status reports, petitions, journal publications, unpublished data from species experts) using formal citation format):

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Samoa. Unpublished report submitted to U.S. Fish and Wildlife Service, Pacific Region, Honolulu. 30 pp.

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LISTING PRIORITY (place * after number)

THREAT			
Magnitude	Immediacy	Taxonomy	Priority

High	Imminent	Monotypic genus	1
		Species	2*
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, removal of candidates, and listing priority changes.

Approve: Don Weathers April 2, 2002
Acting Regional Director, Fish and Wildlife Service Date

Concur: _____ _____
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Director's Remarks: _____

_____

_____

Date of annual review: 2/02
Conducted by: _____

Comments: _____

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(rev. 1/02)